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EARTHQUAKE HAZARD MITIGATION OF TRANSPORTATION FACILITIES FOR GRAVES COUNTY

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16. Abstract

Concern has grown in recent years over the seismic activity of the New Madrid seismic zone in Western Kentucky. Graves County, Kentucky is located in this region. To permit emergency medical, supply, and equipment traffic into this area after an earthquake has occurred, the Kentucky Transportation Cabinet is interested in the possibility of keeping selected routes passable. This report lists the routes that have been investigated and recommended as being the routes in Graves County that should be maintained in a passable condition. The recommended routes, KY 94, KY 121, KY 58/KY 80, US 45/KY 58, US 45, and KY 58, have been visually surveyed and all seismically significant features cataloged. These features are logged by their location on strip maps contained in Appendix A and a detailed listing of all the potentially critical features is given in Appendix B.

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INTRODUCTION

An awareness of earthquakes and their possible effects upon the nation's infrastructure is critically important to the public, and in particular, to public officials. The nation's highway system is one of the most important components of the infrastructure. After the occurrence of an earthquake, the highway system is the primary mode of transporting emergency supplies and services into an affected area. Thus, it is important to catalog the important components of the highway system and attempt to anticipate the possible damage to these components from an earthquake.

Western Kentucky in general and Graves County in particular are in a high risk earthquake zone. In 1811-1812, three of the most severe earthquakes in American history shook the country. The location of these quakes was not on the infamous San Andreas fault nor anywhere along the well-known fault laden Pacific coast but was near a small town on the Mississippi River where the states of Kentucky and Missouri share a border (Figure 1). It is this river town, New Madrid, Missouri, that is the namesake of a region now regarded by seismologists and disaster response planners as the most hazardous earthquake zone east of the Rocky Mountains -- the New Madrid seismic zone.

In addition to these three great earthquakes, there are several other well documented factors demonstrating the susceptibility of the New Madrid region to the recurrence of major earthquakes. Through a decade of extensive research, an ancient crustal rift has been found to underlie the relatively shallow sediments comprising the region's surface. This type of geologic structure is prone to seismic activity. The New Madrid rift has been identified as being of sufficient size to generate major earthquakes. Further evidence of the area's seismicity is the record of over 2,000 earthquakes detected in the zone since 1974. Though most have been of a magnitude below the threshold of human perception, their existence clearly indicates the high level of seismic activity occurring in the zone.

Seismologists have calculated the probabilities of recurrence of sizeable earthquakes in the New Madrid rift zone. The probability of a magnitude 6.3 earthquake (Richter scale) within 50 years is from 86 to 97 percent. The probability (1) of that same earthquake occurring within the next 15 years is from 40 to 63 percent. For comparison, the 1971 San Fernando earthquake (magnitude 6.6) killed 58 people and caused $480 million worth of damage. The 1988 Armenian earthquake of similar magnitude killed approximately 25,000 to 30,000 people.

The probability of a magnitude 7.6 earthquake occurring within 50 years is from 19 to 29 percent. The probability for this size earthquake occurring within 15 years drops to a range of 5.4 to 8.7 percent. On February 4, 1975, the Haicheng earthquake in China had a magnitude of 7.3 and destroyed or damaged about 90 percent of the structures in a city of 90,000 people.

When comparing historical earthquakes of similar magnitude, one must take into consideration

that death totals and damage estimates will vary greatly due to the geology, population density, types of building, and quality of construction.

For a given earthquake, effects at a given location are described by the Modified Mercalli Intensity (MMI) scale (2) which ranges from I (no damage and felt only by instruments) to XII (total destruction). Details of the MMI scale are given in Table 1. Values of MMI associated with the 1811-1812 earthquakes are shown in Figure 1. The potential for damage and destruction from earthquakes in the region is significant.

In 1982, the Governor's Task Force on Earthquake Hazards and Safety was created to evaluate Kentucky's earthquake risk and to make recommendations for responding to those risks. This task force recommended increased public awareness and education programs, improved emergency response planning and training, improved building codes and seismic restraint designs, evaluation of other mitigation measures, and participation in national and regional earthquake forums and funding programs.

In 1984, Governor Collins created the Governor's Earthquake Hazards and Safety Technical Advisory Panel (GEHSTAP) to analyze scientific and engineering data regarding seismic risks in Kentucky and to make specific recommendations on mitigation, public awareness, response planning, and policy development for public health and safety. The States are dependent on their highway systems for the movement of goods and services. Due to the possible adverse effects a major earthquake could have on this system, the Earthquake Stability and Transportation Subcommittee (ESTS) of GEHSTAP was formed.

ESTS has encouraged the Kentucky Transportation Cabinet to secure funding for generating and implementing an earthquake hazard mitigation plan in an attempt to safeguard the highway system against catastrophic earthquake failure. As a result, the Cabinet commissioned the Kentucky Transportation Center at the University of Kentucky to analyze and assess the possible effects of an earthquake on highway facilities. The study area includes the 26 western-most counties in Kentucky that are adjacent to the New Madrid seismic zone (Figure 1). To date, one of the results of that study has been the recommendation that over 1,000 miles of highways in the study area be utilized as emergency or "priority" routes. These would be the primary routes used for transporting emergency supplies and personnel after an earthquake. Also, it is anticipated that these would be the first routes repaired after an earthquake.

The initial task in identifying these priority routes was to decide where they should begin; that is, in the event of a major earthquake, the point at which the transport of goods and services would originate. Ideally, the city chosen should possess the following attributes:

1. Sufficient size to contain all necessary personnel, supplies, and facilities to respond quickly to a major emergency;

2. Proximity to the high hazard area to speed the relief effort but not so close as to suffer the same high risk potential;

3. Easy access from other major cities in the State; and

4. Sufficient routes to provide relatively direct access to all 26 high-risk counties.

The city best fitting these criteria is Bowling Green. Located at the eastern edge of the earthquake zone in Warren County, Bowling Green meets both the size criterion (population 40,450) and the accessibility criterion (Louisville and Nashville via I 65 and Lexington via the Bluegrass Parkway). Bowling Green provides access to the 26-county area via US 68/KY 80; this road was chosen as the main east-west artery because it crosses Lake Barkley and Kentucky Lake upstream from the dams impounding those bodies of water.

As a first step towards establishing an overall policy for earthquake hazard mitigation in the highway system, these priority routes have been visually surveyed and all natural and man-made features along these routes that are considered seismically significant were cataloged. With this information, a realistic and cost-effective plan for "hardening" these routes against earthquakes can be established. Such efforts are currently under way.

PRIORITY ROUTE IN GRAVES COUNTY

Graves County is located approximately 35 miles east of the center of the New Madrid Seismic Zone. Figure 1 indicates that Graves County is located in IX band of the MMI scale. This indicates considerable damage could occur in Graves County in the event of a major earthquake.

KY 94, KY 121, KY 58/KY 80, US 45/KY 58, US 45, and KY 58 have been designated as the priority routes for Graves County. KY 94 starts at the Graves County-Hickman County line and continues east for 19.70 miles, ending at the Graves County-Calloway County line. KY 121 starts at the Graves County-Calloway County line and continues north for 22.60 miles, ending at the Graves County-Carlisle County line. KY 58/KY 80 starts at the junction of KY 58 and KY 80 and continues east for 9.40 miles, ending at the Graves County-Marshall County line. US 45/KY 58 starts at milepost 10.50 and continues east for 5.4 miles, ending in the city of Mayfield. US 45 starts at the Graves County-Hickman County line and continues east for 10.50 miles, ending at the junction of KY 58. KY 58 starts at the Graves County-Hickman County line and continues east for 5.45 miles, and joins KY 45.

A number of features along the priority routes could potentially hamper rescue and relief efforts. These features included bridges, soil fills, gas pipelines, power lines, large trees, water impoundments, radio towers, a water tower, quarries, grain silos, and buildings. These features are logged by their location on strip maps contained in Appendix A and a detailed listing of all potentially critical features is given in Appendix B.

BRIDGES

Bridges are the most significant and important features on the priority route. With few exceptions, existing highway bridges in the study area have not been designed to resist motions and forces that may be generated by earthquakes. Bridges located within the seismic zone could possibly be damaged, thus reducing their load-carrying ability. In some cases, damage could be sufficiently great to cause complete collapse. Several types of damage could occur:

1. A bridge could fail at the bearing which supports the main spans, causing the spans to fall from the bearings and possibly from the piers or abutments.

2. Failure could occur in the columns, piers, or footings which would reduce the load-carrying capacity of the bridge, if the bridge was still in place.

3. An abutment could tilt allowing the entire span to fall.

4. Soil movement or slumping could affect the bridge approach fills, damaging the abutments or piers, or making the bridge inaccessible.

There are four bridges on KY 94, six bridges on KY 121, three bridges on KY 58/KY 80, three bridges on US 45/KY 58, six bridges on US 45, and three bridges on KY 58 in Graves County. The bridges are located at the following:

KY 94

1. Unnamed stream,
2. Pirtle Creek,
3. Pirtle Creek Bottom, and
4. Pirtle Creek Bottom.

KY 121

1. Mayfield Creek,
2. Mayfield Creek Overflow,
3. Branch of Mayfield Creek,
4. Over Kess Creek,
5. Mayfield Bypass, and
6. I.C.R.R.

US 45/KY 58

1. Obion Creek,
2. Opossum Creek, and
3. Richard Creek.

US 45

1. Bayou De Chien,
2. Jackson Creek,
3. Brush Creek,
4. Cane Creek,
5. Branch of Cane Creek, and
6. I.C.R.R. (In downtown Mayfield).

KY 58

1. Brush Creek,
2. Cane Creek, and
3. Jackson Purchase Parkway.

KY 58/KY 80

1. Mayfield Creek,
2. Panther Creek, and
3. Fork of Panther Creek.

Research is currently under way studying the effects that an earthquake could have on these bridges and their approach fills.

FILLS

Highway fills are particularly important because of their tendency to fail from seismically induced motions. Fills fail in one of two major modes. The first is a generalized circular or wedge-shaped failure resulting in one or both traffic lanes moving down and out. If both lanes failed, this would certainly render the route impassable and immediate repairs would be necessary. The second mode of failure is a general slumping or settling of the embankment. The roadway would probably remain passable if settlement or slumping were not severe but reduced speed limits would be required for safety.

Large fills on priority routes in Graves County are located as follows:

KY 94

1. Approach fills for the bridge over unnamed stream,
2. 0.32 mile west of Pirtle Creek bridge,
3. Approach fills for the bridge over Pirtle Creek,
4. Approach fills for the two bridges over Pirtle Creek Bottom,
5. 0.40, 0.50, 0.65, and 1.60 miles west of the junction of KY 129 (north) and KY 94, and
6. 0.35 mile west of junction KY 83 (west) and KY 94.

KY 121

1. 0.40 mile south of the junction of KY 564 (south) and KY 94,
2. Approach fills for the bridge over Mayfield Creek,
3. Approach fills for the bridge over Mayfield Creek Overflow,
4. Approach fills for the bridge over a Branch of Mayfield Creek,
5. Approach fills for the Kess Creek bridge,
6. Approach fills the bridge over the Mayfield Bypass,
7. 1.20 miles north of the junction of KY 1890 (west) and KY 121,
8. 0.80 and 2.40 miles north of the junction of KY 440 and KY 121,
9. 0.30 mile south of the junction of KY 1213 and KY 121,
10. 0.10 mile north of the junction of KY 1213 and KY 121,
11. Approach fills for the bridge over I.C.R.R., and
12. 0.30, 0.60, and 0.90 mile south

of the Graves County-Carlisle County line.

KY 58/KY 80

1. Approach fills for the bridge over Mayfield Creek,
2. 1.70 miles east of the junction of KY 131 (north) and KY 58/KY 80,
3. Approach fills for the bridge over Panther Creek,
4. Approach fills for the bridge over a Fork of Panther Creek, and
5. 0.60 mile west of the junction of KY 564 (south) and KY 58/KY 80.

US 45/KY 58

1. Approach fills for the bridge over Obion Creek,
2. Approach fills for the bridge over Opossum Creek, and
3. Approach fills for the bridge over Richard Creek.

US 45

1. Approach fills for the bridge over Bayou De Chien,
2. Approach fills for the bridge over Jackson Creek,
3. Approach fills for the Brush Creek bridge,
4. Approach fills for the Cane Creek bridge,
5. Approach fills for the bridge over the Branch of Cane Creek, and
6. Approach fills for the bridge over I.C.R.R. in the City of Mayfield.

KY 58

1. Approach fills for the Brush Creek bridge,
2. Approach fills for the Cane Creek bridge,
3. 1.07 miles east of the Cane Creek bridge, and
4. Approach fills for the bridge over the Jackson Purchase Parkway.

POWER LINES

High voltage power lines also were cataloged during the route surveys. The heights of the lines above the roadway were estimated visually. Power company officials speculated that a number of breaks along each power line would occur during a major earthquake. In most cases, fallen lines would not be transmitting power because power would be automatically cut off within a few seconds in the event of a break.

Additionally, power line support towers could potentially fall across a priority route.

Power lines cross priority routes at the following locations:

KY 94

1. At the Graves County-Hickman County line,
2. 1.20, 0.20 and 2.20 miles east

of the junction of KY 129 (south) and KY 94,

3. 0.40 mile east of the junction of KY 385 and KY 94, and

4. 0.40 mile east of the junction of KY 564 (north) and KY 94.

KY 121

1. 0.10 mile north of the Graves County-Calloway County line,

2. 0.20 and 1.20 miles north of the junction of KY 1890 (west) and KY 121, and

3. 0.15 mile north of the Kess Creek bridge.

KY 58/KY 80

1. 0.12 mile east of the Mayfield Creek bridge, and

2. 0.10 mile east of the junction of KY 564 (south) and KY 58/KY 80.

US 45/KY 58

1. 0.26 mile east of Obion Creek bridge, and

2. 1.10, 1.15, 1.92, and 2.80 miles east of the Richard Creek bridge.

US 45

1. 0.20 and 0.80 mile east of the Graves County-Hickman County line,

2. 0.20, 1.00, and 1.10 miles east of the Jackson Creek bridge,

3. 0.10 mile east of the junction of KY 1763 (northwest) and US 45, and

4. 0.10 and 1.75 miles west of the junction of KY 58 and US 45.

GAS PIPELINES

Several gas pipelines cross under the priority routes in Graves County. It is possible that pipe lines could fail under or near a priority route causing a temporary closure. If a pipeline failed, an explosion might destroy a section of the priority route. Repair could be delayed by further gas leaks, fire, and/or additional explosions.

It appears that most of the pipe lines in Graves County were constructed with little or no seismic considerations. Gas pipelines cross under the priority routes at the following locations:

KY 94

1. 0.45, and 0.50 mile east of the Pirtle Creek bridge.

KY 121

1. 0.03 mile north of the bridge over the Mayfield Creek Overflow.

KY 58/KY 80

1. At the junction of KY 1710 (north) and KY 58/KY 80.

US 45/KY 58

1. 1.05 miles east of the Richard Creek bridge.

TREES

The behavior of trees during an

earthquake depends upon many factors including their condition, type, height, and size. Local soil conditions, geometry of the ground surface, and characteristics of the earthquake can also be important. Violent ground motions accompanied by surface rupture and perhaps permanent displacement of the soil surface produce sudden surface accelerations of the ground which can snap and uproot large trees (3).

Trees are so numerous that, if many of them fell, the priority routes in Graves County could effectively be blocked for several hours or days before emergency crews could clear the debris. Groups of large trees are located near the road at the following sites:

KY 94

1. 0.10 mile west of junction KY 943 (south) and KY 94,
2. 0.75, 0.80, and 1.18 miles east of the junction of KY 943 (south) and KY 94,
3. 0.10 and 0.50 mile east of the Pirtle Creek bridge,
4. 0.40 and 1.20 miles west of the junction of KY 129 (north) and KY 94,
5. 0.10, 1.60, 1.90, and 2.40 miles east of the junction of KY 129 (north) and KY 94,
6. At the junction of KY 385 (north) and KY 94,
7. At the junction of KY 385 (south) and KY 94,
8. 0.80, 1.00, and 1.20 miles east of the junction of KY 385 (south) and KY 94,
9. 0.80 and 2.50 miles east of the junction of KY 303 and KY 94,
10. 0.20, 0.40, 0.70, 1.10, 1.60, and 2.00 miles east of the junction of KY 1382 (heading south west) and KY 94,
11. 0.45 and 0.90 mile east of the junction of KY 83 (west) and KY 94, and
12. 0.10, 0.55, 0.80, 0.95, 1.30, 1.50, 1.80, 1.90, and 2.10 miles east of junction KY 97 and KY 94.

KY 121

1. 0.20, 0.70, 1.20, 1.40, 1.90, 2.40, and 3.0 miles north of the Graves County-Calloway County line,
2. 0.20, 0.70, 1.30, and 1.80 miles north of the junction of KY 1890 (west) and KY 121,
3. 0.20, 0.60, and 1.50 miles north of the junction of KY 1124 (east) and KY 121,
4. 0.04 mile north of the Mayfield Creek bridge,
5. 0.57 mile north of the Mayfield Bypass,
6. 0.50, 1.50, and 1.70 miles north of the junction of KY 1890 (west) and KY 121,
7. 0.40 and 0.90 mile south of the junction of KY 1213 and KY 121,
8. 0.19 mile south of the bridge over the I.C.R.R., and

9. 1.31 miles north of the bridge over the I.C.R.R.

KY 58/KY 80

1. 0.12 mile west of the junction of KY 131 (north) and KY 58/KY 80,

2. 1.00, 1.55, 1.60, 2.40, and 2.70 miles east of the junction of KY 131 (north) and KY 58/KY 80,

3. 0.80, 0.70, 0.30, 0.24 mile, and at the junction of KY 301 (north) and KY 58/KY 80,

4. 1.06 miles north of the bridge over a Fork of Panther Creek, and

5. 0.30 mile south of the Graves County-Marshall County line.

US 45

1. 0.30 and 1.40 miles east of the Graves County-Hickman County line,

2. At the Jackson Creek bridge and 1.10 miles east of the bridge,

3. 0.59 and 1.80 miles east of the junction of KY 1763 (heading northwest) and US 45,

4. At the Cane Creek bridge, and

5. 0.44 mile east of the bridge over a Branch of Cane Creek.

KY 58

1. 0.20, 0.50, 0.60, and 0.90 mile east of the Graves County-Hickman County line,

2. 0.50, 0.80, 1.00 mile east of the junction of KY 339 (heading southeast) and KY 58, and

3. 0.27, 1.67, and 2.07 miles east of the Cane Creek bridge.

WATER IMPOUNDMENTS

Small impoundments such as large farm ponds could also be a problem area. Ponds which have large earthen dams that lie above the road surface could collapse during an earthquake and wash out a section of a priority route. Ponds which lie below the road surface and are adjacent to the toe of the fill could cause failures in the fill during an earthquake due to the high moisture content. Several of the ponds were logged from geologic quadrangle maps, therefore they may not be visiable from the priority route.

Impoundments are located as follows:

KY 94

1. 0.80 mile west of the junction of KY 129 (south) and KY 94,

KY 121

1. 0.75 mile south of the junction of KY 1124 (east) and KY 121,

2. 0.50 mile north of the Mayfield Bypass, and

3. 0.60 mile south of the junction of KY 1213 and KY 121.

KY 58/KY 80

1. 0.54 mile east of the Mayfield Creek bridge.

WATER TOWER

A water tower is approximately 150 feet from US 45 at milepost 7.55. It is possible that the tower could fail during a major earthquake and temporarily block the priority route.

RADIO TOWERS

A radio tower is located on KY 94 at the milepost 9.70, and on KY 121 at milepost 9.60. It is possible that the towers could fail during a major earthquake and temporarily block the priority routes.

GRAIN SILOS

Two grain silos located on KY 121 at milepost 3.60 could fail during an earthquake and temporarily block the priority route.

BUILDINGS

Five and four story masonry buildings are located on KY 58/KY 80 in Mayfield at mileposts 5.50 and 5.70, respectively. In many of the cities located on priority routes, there are numerous buildings that are brick veneer and their seismic response is unknown. An analysis of each of those for seismic response would be prohibitive in terms of cost and time. Most cities including Murray should have multiple detours that could be used in the event collapse of a building closed a priority route.

QUARRIES

There are several open pit sand, clay and gravel quarries in Graves County. A major earthquake could collapse portions of the quarry walls and could temporaily block or destroy a section of a priority route. Several of the quarries were logged from geologic quadrangle maps and are not visible from the priority route. Further inspection should be conducted to determine if there is a possible threat to a priority route. Quarries were logged at the following locations:

KY 94

1. 0.09 mile east of the junction of KY 83 (west) and KY 94, and
2. 0.05 mile west of the Graves County-Calloway County line.

KY 121

1. 0.22 mile south of the junction of KY 1890 (west) and KY 121, and
2. 0.43 mile south of the junction of KY 1124 (east) and KY 121.

US 45

1. 0.01 mile to 0.40 mile west of junction KY 1763 (northeast) and US 45,
2. 0.11 mile east of the junction of KY 944 (west) and US 45, and
3. 0.05 mile east of the bridge over the Branch of Cane Creek.

KY 58

1. 0.44 mile east of the Brush Creek bridge.

ALLUVIUM

Soil maps for Graves County indicate that there are moderate amounts of

alluvium present throughout the county. Alluvium is a loose, fine-grain soil which is deposited by flowing water such as creeks and rivers. Due to the nature of the alluvium, ground motions at the surface of the soil can be many times greater than those within the underlying bedrock and temporary liquefaction can occur (Figure 2). An alluvium map for Graves County is shown in Figure 3.

CONCLUSIONS

In 1984, ESTS developed a fivefold plan of action for formulating and implementing a seismic mitigation policy for the western Kentucky seismic zone. To date, the Kentucky Transportation Center has established priority routes for all 26 counties in the western Kentucky seismic zone and developed seismic risk maps of all natural and man-made features that are susceptible to earthquake damage that could jeopardize the priority routes.

Current work is being conducted to analyze these features and make recommendations for hardening them against earthquake damage.

Future work involves training key personnel in the Transportation Cabinet in hazard mitigation and seismic safety; which includes bridge inspectors, district engineers, construction inspectors, designers, and maintenance personnel.

Following the education of key personnel, the mitigation plan proposed by the Kentucky Transportation Center will be reviewed by the Kentucky Transportation Cabinet and a program will be established for implementation. The final step involves the use of relevant seismic codes for all new construction, repair, and maintenance.

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2. Green, N. B., "Earthquake Resistant Building Design and Construction," Third Edition, Elsevier, 1987, Page No. 179-180.

3. Keller, Edward A., "Environmental Geology," Charles E. Merrill Publishing Company, A Bell and Howell Company, 1979, Page No. 157.

Additional Information

The Commonwealth of Kentucky has prepared a State Emergency Operations Procedures (State EOP) manual that is produced by the Division of Disaster and Emergency Services (DES), Department of Military Affairs, Frankfort, 40601. Annexes H. on Transportation and DD on Earthquakes give additional information on disaster preparedness and response.

A copy of the State EOP and information on local hazard mitigation activities and response preparedness are available from the AREA 1 Office of DES which is located in Mayfield. The phone numbers at this office are (502) 564-8601 and (502) 247-9712.

Additional information about the study discussed in this report should be directed to David L. Allen, Project Director, at the Kentucky Transportation Center, (606) 257-4513. Requests to be placed on the mailing list for updated information should be submitted on your company or agency letterhead to the Kentucky Transportation Center at the University of Kentucky, Lexington Kentucky 40506-0043.

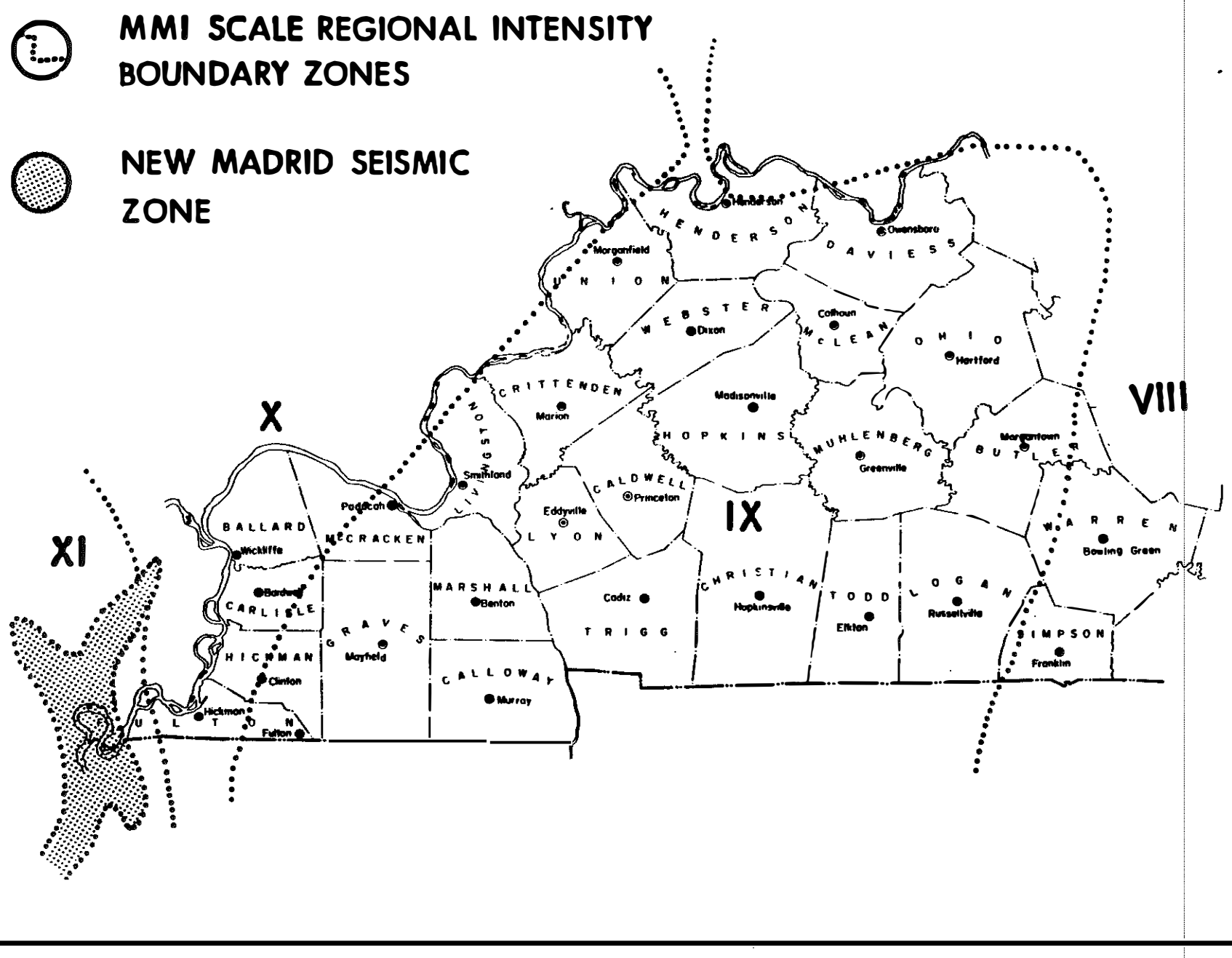


Figure 1: The twenty-six counties included in this study area.

Table 1: MODIFIED MERCALLI INTENSITY SCALE

Modified Mercalli Intensity Scale, 1956 Version

The following comments by Dr. Richter precede the published statement of the intensity scale:

...Each effect is named at the level of intensity at which it first appears frequently and characteristically. Each effect may be found less strongly, or in fewer instances, at the next lower grade of intensity; more strongly or more often at the next higher grade. A few effects are named at two successive levels to indicate a more gradual increase.

Masonry A, B, C, D. To avoid ambiguity of language, the quality of masonry, brick or otherwise, is specified by the following lettering.

Masonry A. Good workmanship, mortar, and design; reinforced, especially laterally, and bound together by using steel, concrete, etc.; designed to resist lateral forces.

Masonry B. Good workmanship and mortar, reinforced by not designed in detail to resist lateral forces.

Masonry C. Ordinary workmanship and mortar; no extreme weakness like failing to tie corners, but neither reinforced nor designed against horizontal forces.

Masonry D. Weak materials, such as adobe; poor mortar; low standards of workmanship; weak horizontally.

The following list represents the twelve grades of the scale.

I. Not felt. Marginal and long-period effects of large earthquakes.

II. Felt by persons at rest, on upper floors, or favorable placed.

III. Felt indoors, Hanging objecta swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.

IV. Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV wooden walls and frame creak.

V. Felt outdoors; direction estimated. Sleepers awakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.

VI. Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken, Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring (church, school). Trees, bushes shaken.

VII. Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices. Same cracks in masonry C. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.

VIII. Steering of motor cars affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundation if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.

IX. General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. Frame structures, if not bolted, shifted off foundations. Frames cracked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluviated areas sand and mud ejected, earthquake fountains, sand crater.

X. Most masonry and frame structures destroyed with their foundations. Some will-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large land slides. Water thrown on banks of canals, river, lakes, etc. Sand and mud shifted horizontally on beaches and flat lands. Rails bent slightly.

XI. Rails bent greatly. Underground pipelines completely out of service.

XII. Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown in the air.

AMPLIFICATION OF SHAKING
AND
DAMAGE DUE TO SHAKING

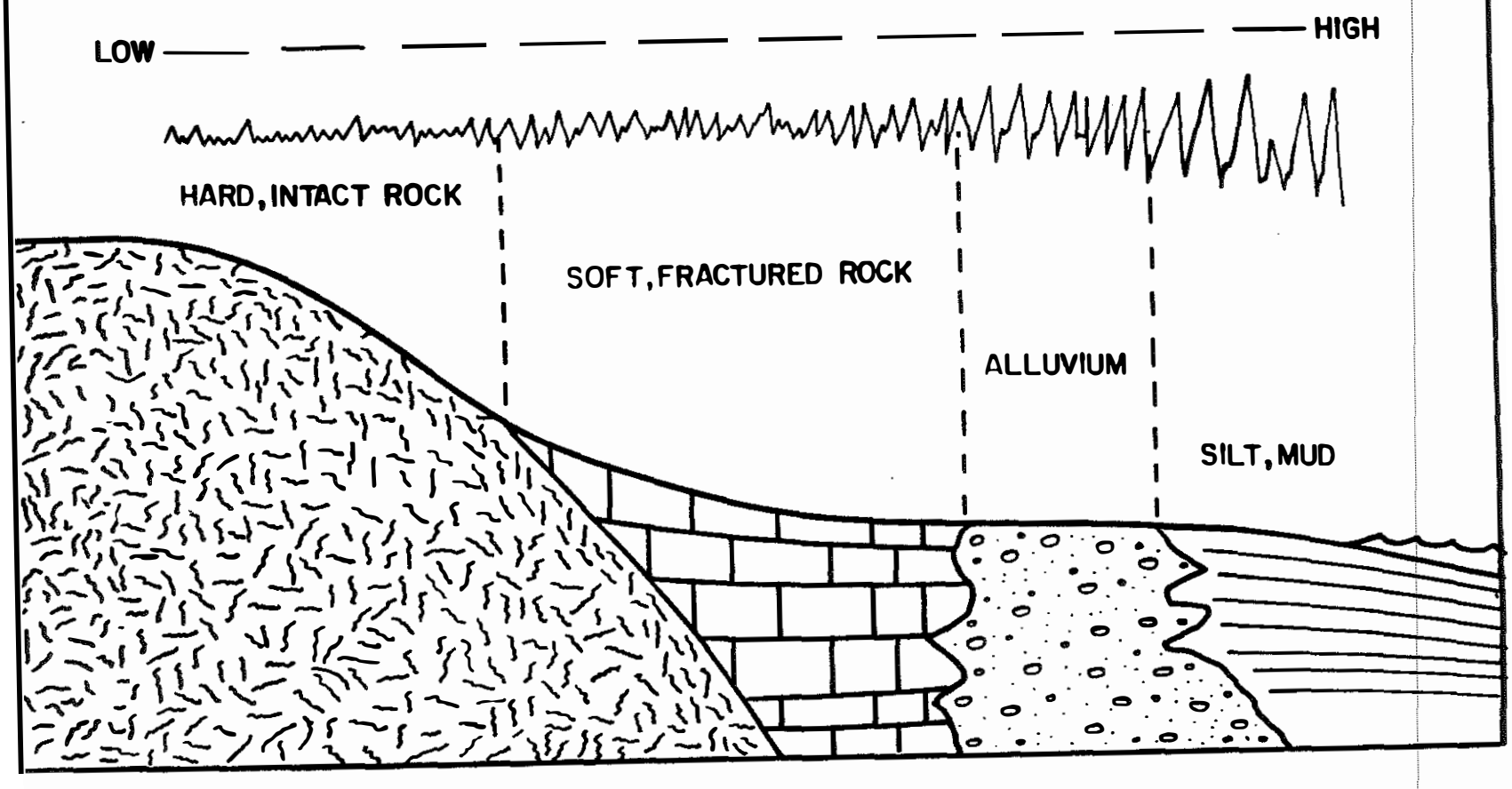


Figure 2 : Amplification of shaking in softer rock & soil during an earthquake.

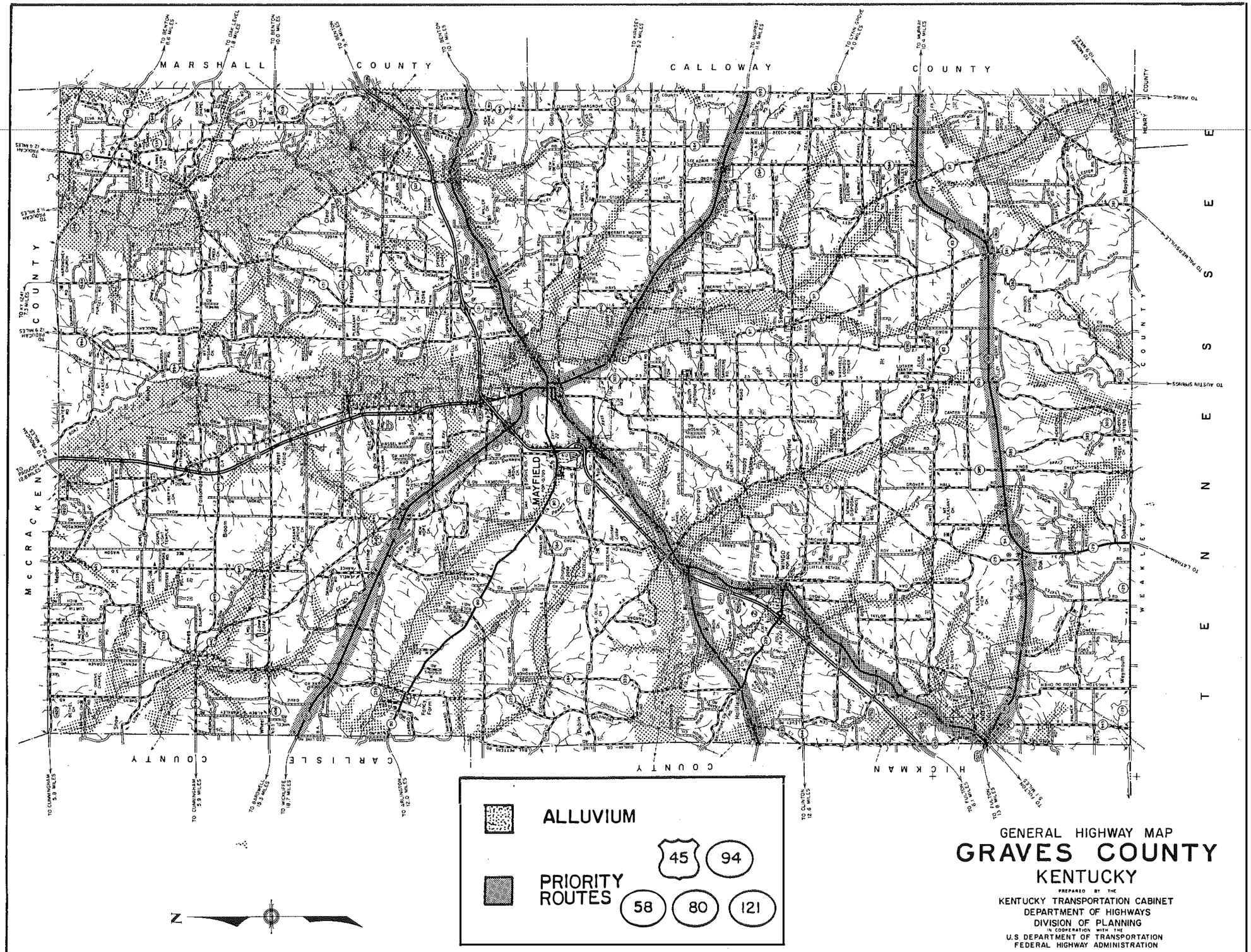


Figure 3. Alluvium map for Graves County.

APPENDIX A

STRIP MAP FOR GRAVES COUNTY

KY 94, KY 121, KY 58/KY 80, US 45/KY 58, US 45, and KY 58

KY94 GRAVES

Start
0.00
0.19
0.40
0.50
1.25
1.30
1.68
2.00
2.10
2.45
2.50
2.50
2.90
2.96
3.70
4.10
4.50
4.65
4.80
4.90
5.30
5.40
5.60
5.80
6.0
6.40
6.50
6.80
6.90
7.20
7.70
7.80
8.00
9.30
9.50
9.70
10.0
Continued
LEGEND OF FEATURES
BRIDGE
TREE
PIPELINE
CUT SLOPE
POWER LINE
MINE
BUILDING
SIGN
TANK
FILL
FAULT
DAM
OTHER
SEE REPORT FOR DESCRIPTIONS OF OTHER

KY94 GRAVES

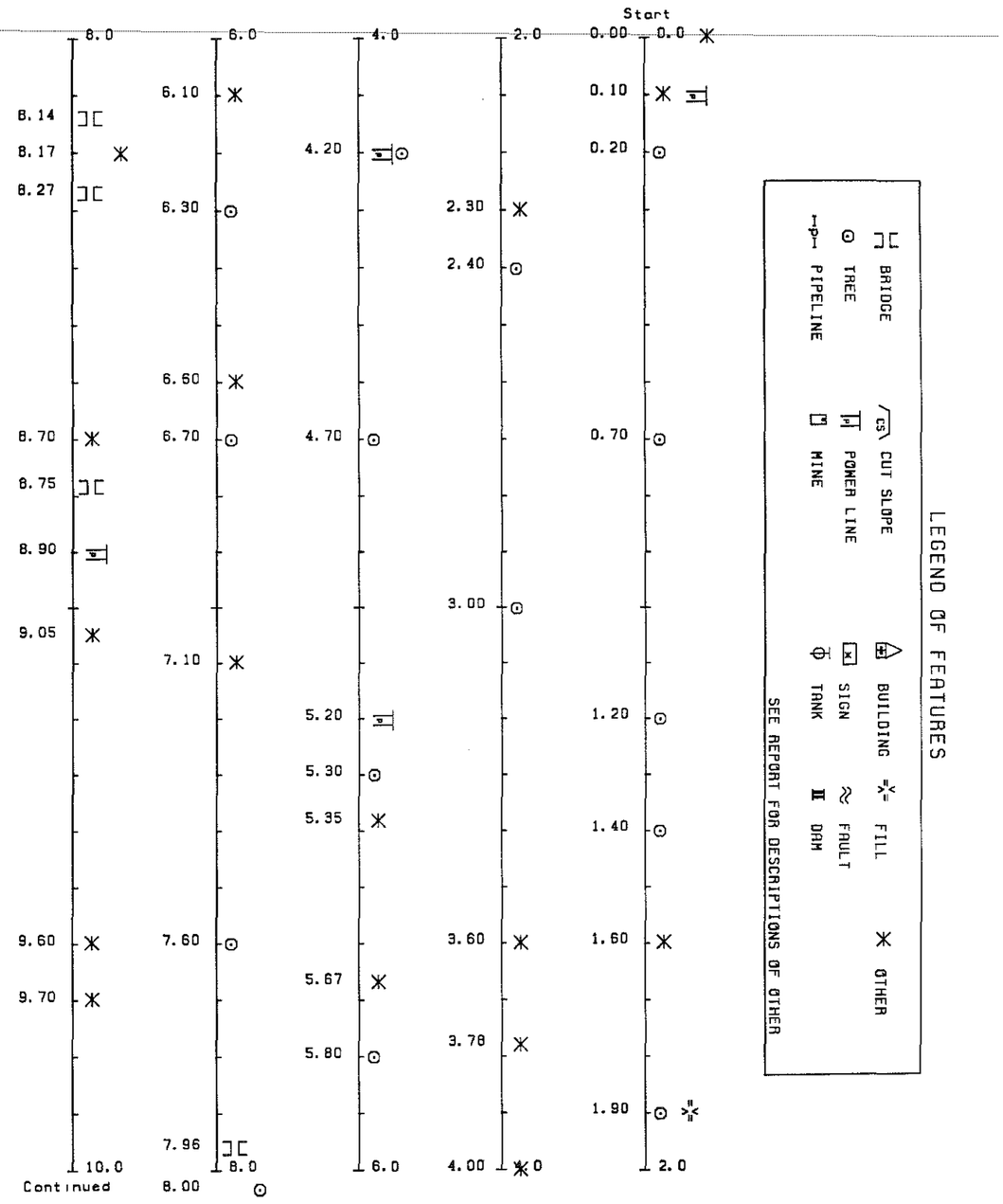
Continued

LEGEND OF FEATURES

BRIDGE	CUT SLOPE		
TREE	POWER LINE		OTHER
PIPELINE	MINE		
BUILDING	FILL		
SIGN	FAULT		
TANK	DAM		

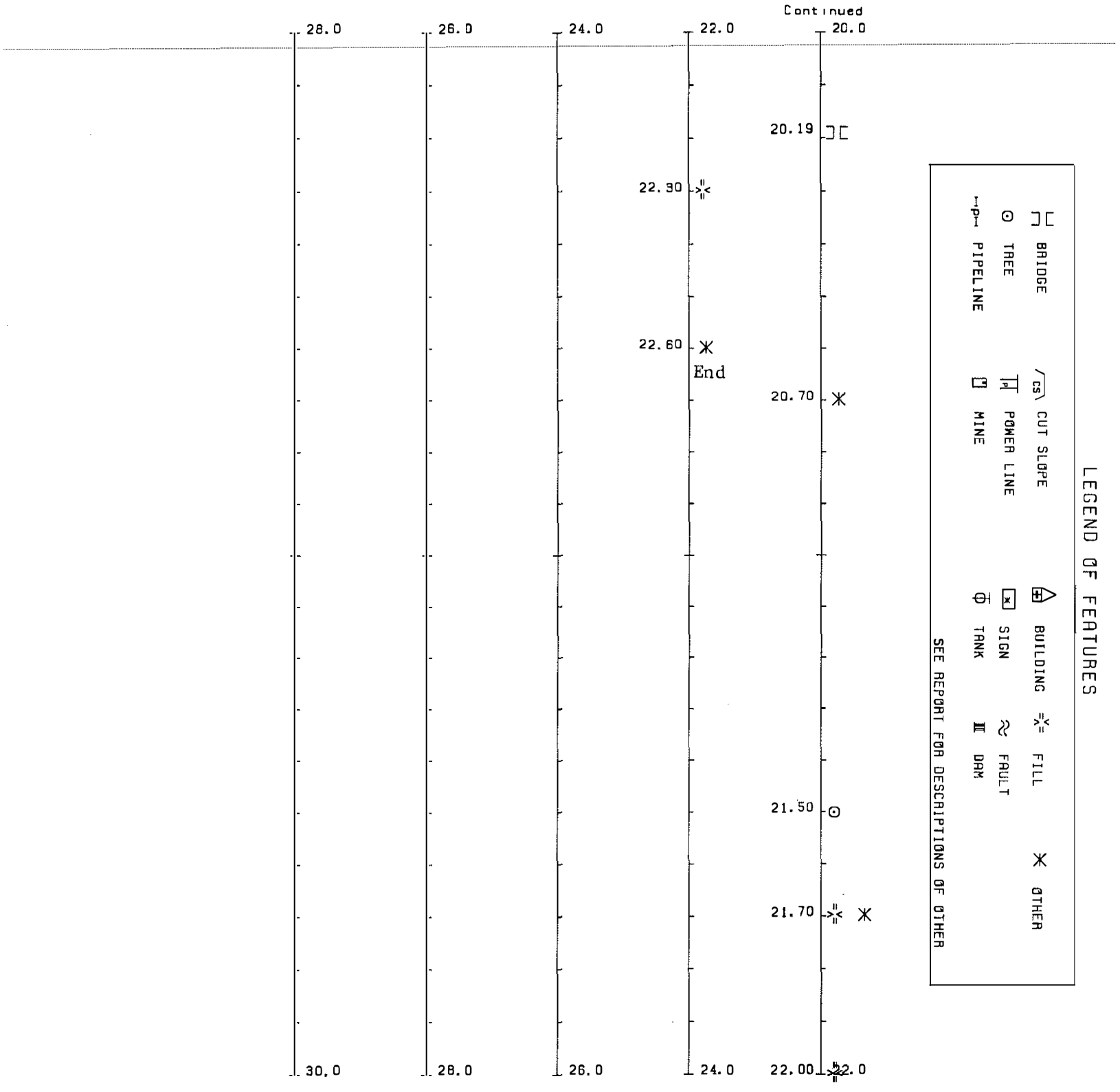
SEE REPORT FOR DESCRIPTIONS OF OTHER

KY121 GRAVES



KY121 GRAVES

KY121 GRAVES

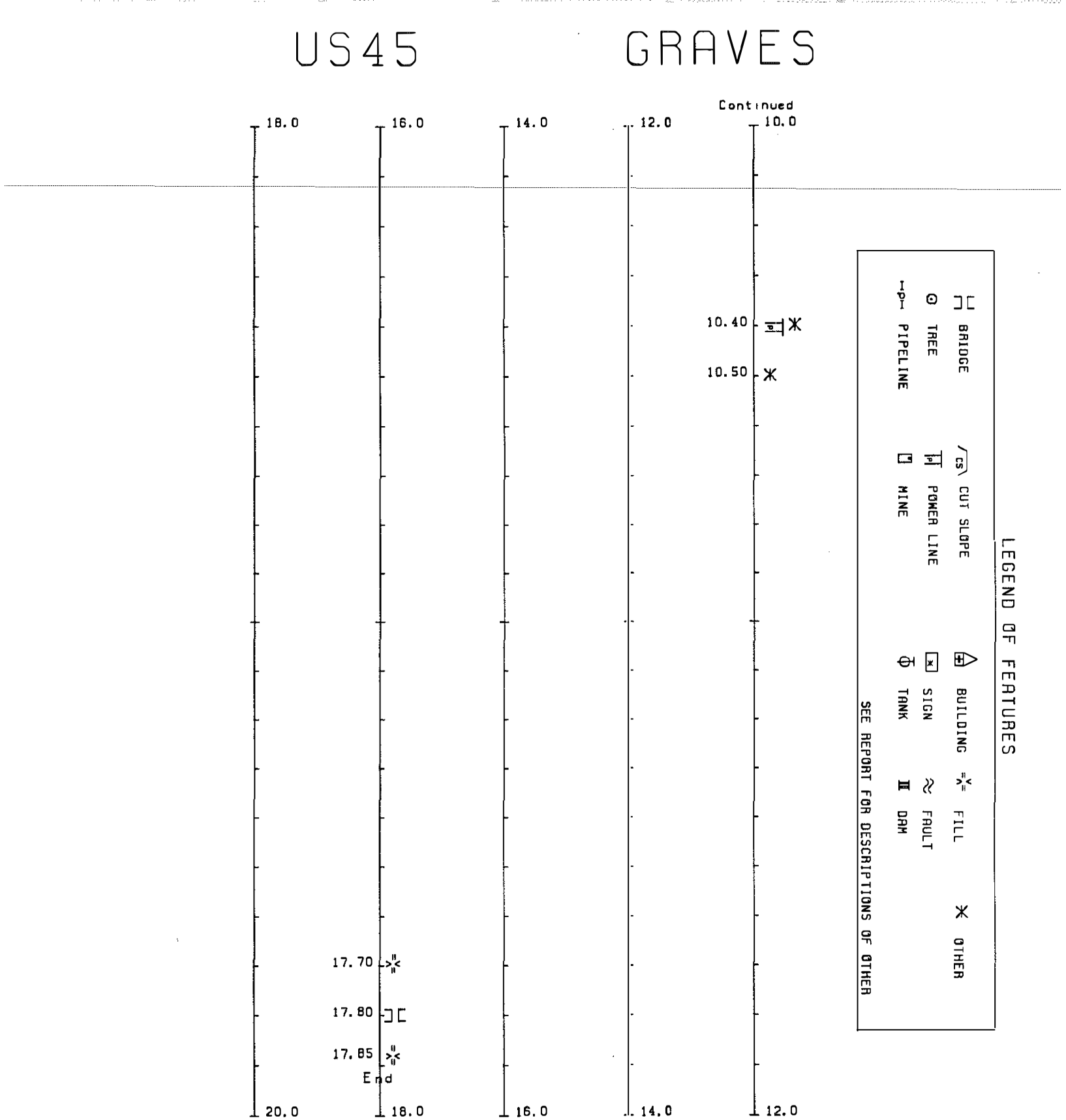


KY58KY80 GRAVES

US45KY58 GRAVES

US45 GRAVES

Continued


US45
GRAVES
Continued
18.0
16.0
14.0
12.0
10.0
10.40
10.50
17.70
17.80
17.85
End
20.0
18.0
16.0
14.0
12.0
LEGEND OF FEATURES
BRIDGE
CUT SLOPE
BUILDING
TREE
POWER LINE
SIGN
PIPELINE
MINE
TANK
FILL
OTHER
FAULT
DAM
SEE REPORT FOR DESCRIPTIONS OF OTHER

KY58 GRAVES

Start
End
0.00
0.20
0.45
0.50
0.51
0.60
0.90
0.95
1.60
2.10
2.40
2.60
2.83
3.10
3.90
4.50
4.90
5.10
5.27
5.30
5.45
0.0
2.0
4.0
6.0
8.0
10.0
LEGEND OF FEATURES
BUILDING
FILL
OTHER
SIGN
FAULT
TANK
DAM
BRIDGE
TREE
PIPELINE
CUT SLOPE
POWER LINE
MINE
SEE REPORT FOR DESCRIPTIONS OF OTHER

APPENDIX B

SEISMICALLY SIGNIFICANT FEATURES

Report by Road and Milepoint
for Graves County - Kentucky
KY 94

Milepoint	Feature	Data
0.00	Other	Graves Co - Hickman Co Boundary Road Surface Type - Composite
0.00	Other	Junction US 45 Heading Northeast-Southwest Road Surface Type - Flexible
0.00	Power Line	Electrical Power Line 3 Lines Height 35 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
0.19	Bridge	Number of Spans 1 Unknown Type Concrete Box Beam End 1 Fixed End 2 Fixed Deck Type - Concrete Length 32 feet Width 27 feet Pier Type - Unknown SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Stub End 2 Substructure - Stub Foundation Type - Unknown
0.40	Trees	Number of Trees 100 Height 45 feet Diameter 8 in. Ending Milepoint 0.90 Distance From Road 10 feet Road Surface Type - Flexible
0.50	Other	Junction KY 943 Headed South Road Surface Type - Flexible
1.25	Trees	Number of Trees 20 Height 40 feet Diameter 16 in. Ending Milepoint 1.50 Distance From Road 10 feet Road Surface Type - Flexible
1.30	Trees	Number of Trees 40 Height 50 feet Diameter 18 in. Ending Milepoint 1.40 Distance From Road 15 feet Road Surface Type - Composite

Report by Road and Milepoint
for Graves County - Kentucky
KY 94

Milepoint	Feature	Data
1.68	Fill	Material Type - Soil Height 15 feet Side slope 2:1 Length 100 feet Crest 20 feet Type Fill - Other Road Surface Type - Flexible
1.68	Trees	Number of Trees 20 Height 45 feet Diameter 12 in. Ending Milepoint 1.93 Distance From Road 8 feet Road Surface Type - Flexible
2.00	Bridge	Number of Spans 4 Over Stream Concrete Box Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed End 2 Fixed Deck Type - Concrete Length 122 feet Width 20 feet Pier Type - Unknown SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Stub End 2 Substructure - Stub Foundation Type - Unknown
2.10	Trees	Number of Trees 60 Height 60 feet Diameter 20 in. Ending Milepoint 2.30 Distance From Road 5 feet Road Surface Type - Flexible
2.45	Pipeline	Pipeline Type - Gas Road Surface Type - Flexible
2.50	Pipeline	Pipeline Type - Natural Gas Road Surface Type - Composite
2.50	Trees	Number of Trees 4 Height 40 feet Diameter 30 in. Ending Milepoint 2.50 Distance From Road 10 feet Road Surface Type - Composite

Report by Road and Milepoint
for Graves County - Kentucky
KY 94

Milepoint	Feature	Data
2.90	Bridge	Number of Spans 3 Over Stream Steel Girder End 1 Fixed Pier 1 Fixed Pier 2 Fixed End 2 Fixed Deck Type - Concrete Length 91 feet Width 20 feet Pier Type - Unknown SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Stub End 2 Substructure - Stub Foundation Type - Unknown
2.96	Bridge	Number of Spans 3 Over Stream Concrete Box Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed End 2 Fixed Deck Type - Concrete Length 91 feet Width 20 feet Pier Type - Unknown SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Stub End 2 Substructure - Stub Foundation Type - Unknown
3.70	Fill	Material Type - Soil Height 20 feet Side slope 2:1 Length 50 feet Crest 24 feet Type Fill - Other Road Surface Type - Flexible
4.10	Trees	Number of Trees 40 Height 40 feet Diameter 10 in. Ending Milepoint 4.60 Distance From Road 15 feet Road Surface Type - Composite
4.50	Other	Pond Road Surface Type - Flexible
4.65	Fill	Material Type - Soil Height 20 feet Side slope 2:1 Length 50 feet Crest 24 feet Type Fill - Other Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
KY 94

Milepoint	Feature	Data
4.80	Fill	Material Type - Soil Height 35 feet Side slope 2:1 Length 50 feet Crest 25 feet Type Fill - Other Road Surface Type - Composite
4.90	Fill	Material Type - Soil Height 35 feet Side slope 2:1 Length 50 feet Crest 25 feet Type Fill - Other Road Surface Type - Composite
4.90	Trees	Number of Trees 30 Height 45 feet Diameter 12 in. Ending Milepoint 5.10 Distance From Road 15 feet Road Surface Type - Composite
5.30	Other	Junction KY 129 Heading North Road Surface Type - Composite
5.40	Trees	Number of Trees 10 Height 40 feet Diameter 30 in. Ending Milepoint 5.41 Distance From Road 15 feet Road Surface Type - Flexible
5.60	Other	Junction KY 129 Heading South Road Surface Type - Composite
5.80	Power Line	Power Lines Parallel to Road (5.8 - 4.8) Milepoint Road Surface Type - Flexible
6.80	Power Line	Electrical Power Line 3 Lines Height 45 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
6.90	Trees	Number of Trees 20 Height 45 feet Diameter 12 in. Ending Milepoint 6.95 Distance From Road 15 feet Road Surface Type - Composite

Report by Road and Milepoint
for Graves County - Kentucky
KY 94

Milepoint	Feature	Data
7.20	Trees	Number of Trees 20 Height 55 feet Diameter 12 in. Ending Milepoint 7.25 Distance From Road 15 feet Road Surface Type - Composite
7.70	Trees	Number of Trees 30 Height 40 feet Diameter 12 in. Ending Milepoint 7.80 Distance From Road 20 feet Road Surface Type - Flexible
7.80	Power Line	Electrical Power Line 3 Lines Height 45 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
8.00	Trees	Number of Trees 20 Height 45 feet Diameter 18 in. Ending Milepoint 8.10 Distance From Road 20 feet Road Surface Type - Flexible
8.00	Other	Junction KY 385 Heading North-South Road Surface Type - Composite
8.40	Power Line	Electrical Power Line 3 Lines Height 35 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
8.50	Other	Junction KY 385 Heading South Road Surface Type - Composite
8.50	Trees	Number of Trees 1 Height 60 feet Diameter 20 in. Ending Milepoint 8.50 Distance From Road 20 feet Road Surface Type - Composite
9.30	Trees	Number of Trees 4 Height 45 feet Diameter 13 in. Ending Milepoint 9.31 Distance From Road 15 feet Road Surface Type - Composite

Report by Road and Milepoint
for Graves County - Kentucky
KY 94

Milepoint	Feature	Data
9.50	Trees	Number of Trees 10 Height 45 feet Diameter 13 in. Ending Milepoint 9.51 Distance From Road 15 feet Road Surface Type - Composite
9.70	Other	Radio Tower (200 feet high) Road Surface Type - Flexible
9.70	Trees	Number of Trees 2 Height 50 feet Diameter 24 in. Ending Milepoint 9.70 Distance From Road 15 feet Road Surface Type - Composite
10.50	Other	Junction KY 303 Heading North-South Road Surface Type - Composite
11.30	Trees	Number of Trees 90 Height 40 feet Diameter 12 in. Ending Milepoint 11.60 Distance From Road 15 feet Road Surface Type - Flexible
13.00	Trees	Number of Trees 12 Height 50 feet Diameter 12 in. Ending Milepoint 13.10 Distance From Road 15 feet Road Surface Type - Composite
13.50	Other	Junction KY 1382 Heading Southwest Road Surface Type - Composite
13.70	Trees	Number of Trees 12 Height 50 feet Diameter 18 in. Ending Milepoint 13.72 Distance From Road 15 feet Road Surface Type - Composite
13.90	Trees	Number of Trees 12 Height 50 feet Diameter 18 in. Ending Milepoint 14.00 Distance From Road 15 feet Road Surface Type - Composite

Report by Road and Milepoint
for Graves County - Kentucky
KY 94

Milepoint	Feature	Data
14.10	Other	Junction KY 381 Heading North Road Surface Type - Composite
14.20	Trees	Number of Trees 6 Height 35 feet Diameter 24 in. Ending Milepoint 14.20 Distance From Road 8 feet Road Surface Type - Flexible
14.60	Trees	Number of Trees 20 Height 40 feet Diameter 18 in. Ending Milepoint 14.65 Distance From Road 12 feet Road Surface Type - Flexible
15.10	Trees	Number of Trees 50 Height 35 feet Diameter 8 in. Ending Milepoint 15.40 Distance From Road 10 feet Road Surface Type - Flexible
15.40	Fill	Material Type - Soil Height 15 feet Side slope 2:1 Length 50 feet Crest 25 feet Type Fill - Other Road Surface Type - Composite
15.50	Trees	Number of Trees 40 Height 45 feet Diameter 12 in. Ending Milepoint 15.70 Distance From Road 15 feet Road Surface Type - Composite
15.75	Other	Junction KY 83 Heading West Road Surface Type - Composite
15.84	Other	Gravel Pit Road Surface Type - Flexible
16.20	Trees	Number of Trees 8 Height 35 feet Diameter 8 in. Ending Milepoint 16.25 Distance From Road 15 feet Road Surface Type - Composite

Report by Road and Milepoint
for Graves County - Kentucky
KY 94

Milepoint	Feature	Data
16.65	Trees	Number of Trees 6 Height 45 feet Diameter 30 in. Ending Milepoint 16.65 Distance From Road 15 feet Road Surface Type - Composite
17.20	Other	Junction KY 97 Heading Northwest-Southeast Road Surface Type - Composite
17.30	Trees	Number of Trees 20 Height 45 feet Diameter 15 in. Ending Milepoint 17.50 Distance From Road 15 feet Road Surface Type - Flexible
17.70	Other	Junction KY 564 Heading North Road Surface Type - Composite
17.75	Trees	Number of Trees 15 Height 45 feet Diameter 30 in. Ending Milepoint 17.90 Distance From Road 15 feet Road Surface Type - Composite
18.00	Trees	Number of Trees 2 Height 45 feet Diameter 15 in. Ending Milepoint 18.00 Distance From Road 15 feet Road Surface Type - Composite
18.10	Power Line	Electrical Power Line 6 Lines Height 30 feet Steel Support Structure Unknown Volts Road Surface Type - Composite
18.10	Other	Steel Electrical Tower Road Surface Type - Composite
18.15	Trees	Number of Trees 10 Height 45 feet Diameter 15 in. Ending Milepoint 18.25 Distance From Road 15 feet Road Surface Type - Composite

Report by Road and Milepoint
for Graves County - Kentucky
KY 121

Milepoint	Feature	Data
0.00	Other	Graves Co - Calloway Co Boundary Road Surface Type - Flexible
0.10	Other	Electrical Junction Station Road Surface Type - Flexible
0.10	Power Line	Electrical Power Line 9 Lines Height 30 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
0.20	Trees	Number of Trees 12 Height 45 feet Diameter 18 in. Ending Milepoint 0.21 Distance From Road 15 feet Road Surface Type - Flexible
0.70	Trees	Number of Trees 30 Height 45 feet Diameter 18 in. Ending Milepoint 0.80 Distance From Road 15 feet Road Surface Type - Flexible
1.20	Trees	Number of Trees 25 Height 38 feet Diameter 16 in. Ending Milepoint 1.30 Distance From Road 12 feet Road Surface Type - Flexible
1.40	Trees	Number of Trees 3 Height 50 feet Diameter 30 in. Ending Milepoint 1.41 Distance From Road 15 feet Road Surface Type - Flexible
1.60	Other	Junction KY 564 Heading North Road Surface Type - Flexible
1.90	Trees	Number of Trees 3 Height 45 feet Diameter 18 in. Ending Milepoint 1.91 Distance From Road 15 feet Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
KY 94

Milepoint	Feature	Data
18.50	Trees	Number of Trees 10 Height 45 feet Diameter 15 in. Ending Milepoint 18.51 Distance From Road 15 feet Road Surface Type - Composite
18.70	Trees	Number of Trees 25 Height 50 feet Diameter 12 in. Ending Milepoint 18.75 Distance From Road 20 feet Road Surface Type - Flexible
19.00	Trees	Number of Trees 10 Height 45 feet Diameter 15 in. Ending Milepoint 19.01 Distance From Road 15 feet Road Surface Type - Composite
19.10	Trees	Number of Trees 1 Height 45 feet Diameter 15 in. Ending Milepoint 19.10 Distance From Road 15 feet Road Surface Type - Composite
19.30	Trees	Number of Trees 20 Height 45 feet Diameter 15 in. Ending Milepoint 19.40 Distance From Road 15 feet Road Surface Type - Composite
19.65	Other	Quarry Road Surface Type - Flexible
19.70	Other	Graves Co - Calloway Co Boundary Road Surface Type - Composite

Report by Road and Milepoint
for Graves County - Kentucky
KY 121

Milepoint	Feature	Data
1.90	Fill	Material Type - Soil Height 15 feet Side slope 2:1 Length 21 feet Crest 25 feet Type Fill - Other Road Surface Type - Flexible
2.30	Other	Junction KY 564 Heading South Road Surface Type - Flexible
2.40	Trees	Number of Trees 10 Height 45 feet Diameter 18 in. Ending Milepoint 2.42 Distance From Road 15 feet Road Surface Type - Flexible
3.00	Trees	Number of Trees 200 Height 45 feet Diameter 18 in. Ending Milepoint 3.50 Distance From Road 15 feet Road Surface Type - Flexible
3.60	Other	2 Grain Silos, 50 feet high Road Surface Type - Flexible
3.78	Other	Gravel Pit Road Surface Type - Flexible
4.00	Other	Junction KY 1890 Heading West Road Surface Type - Flexible
4.20	Power Line	Electrical Power Line 6 Lines Height 60 feet Steel Support Structure Unknown Volts Road Surface Type - Flexible
4.20	Trees	Number of Trees 15 Height 45 feet Diameter 18 in. Ending Milepoint 4.40 Distance From Road 15 feet Road Surface Type - Flexible
4.70	Trees	Number of Trees 10 Height 45 feet Diameter 18 in. Ending Milepoint 4.71 Distance From Road 15 feet Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
KY 121

Milepoint	Feature	Data
5.20	Power Line	Electrical Power Line 3 Lines Height 30 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
5.30	Trees	Number of Trees 50 Height 40 feet Diameter 36 in. Ending Milepoint 5.50 Distance From Road 15 feet Road Surface Type - Flexible
5.35	Other	Pond (50 x 80) feet, 30 feet from road Road Surface Type - Flexible
5.67	Other	Abandoned Clay Pits Road Surface Type - Flexible
5.80	Trees	Number of Trees 30 Height 35 feet Diameter 35 in. Ending Milepoint 5.90 Distance From Road 10 feet Road Surface Type - Flexible
6.10	Other	Junction KY 1124 Heading East Road Surface Type - Flexible
6.30	Trees	Number of Trees 20 Height 45 feet Diameter 13 in. Ending Milepoint 6.32 Distance From Road 15 feet Road Surface Type - Flexible
6.60	Other	Junction CO 2205 Road Surface Type - Flexible
6.70	Trees	Number of Trees 3 Height 45 feet Diameter 18 in. Ending Milepoint 6.71 Distance From Road 15 feet Road Surface Type - Flexible
7.10	Other	Junction KY 940 Heading North-South Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
KY 121

Milepoint	Feature	Data
7.60	Trees	Number of Trees 25 Height 50 feet Diameter 24 in. Ending Milepoint 7.61 Distance From Road 10 feet Road Surface Type - Flexible
7.96	Bridge	Number of Spans 7 Over Stream Concrete T-Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed Pier 3 Fixed Pier 4 Fixed Pier 5 Fixed Pier 6 Fixed End 2 Fixed Deck Type - Concrete Length 245 feet Width 24 feet Pier Type - Open SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown
8.00	Trees	Number of Trees 150 Height 45 feet Diameter 18 in. Ending Milepoint 8.40 Distance From Road 15 feet Road Surface Type - Flexible
8.14	Bridge	Number of Spans 4 Over Stream Concrete T-Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed Pier 3 Fixed End 2 Fixed Deck Type - Concrete Length 130 feet Width 24 feet Pier Type - Open SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown
8.17	Other	Underground Pipeline 26 inches diameter Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
KY 121

Milepoint	Feature	Data
8.27	Bridge	Number of Spans 6 Over Stream Concrete T-Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed Pier 3 Fixed Pier 4 Fixed Pier 5 Fixed End 2 Fixed Deck Type - Concrete Length 199 feet Width 24 feet Pier Type - Open SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown
8.70	Other	Junction KY 97 Heading South Road Surface Type - Flexible
8.75	Bridge	Number of Spans 2 Overpass Concrete T-Beam End 1 Fixed Pier 1 Fixed End 2 Fixed Deck Type - Concrete Length 55 feet Width 30 feet Pier Type - Unknown SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown
8.90	Power Line	Electrical Power Line 3 Lines Height 30 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
9.05	Other	Mayfield City Limits Road Surface Type - Flexible
9.60	Other	Radio Tower 150 feet high, 30 feet from road Road Surface Type - Flexible
9.70	Other	Junction KY 303 Heading South Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
KY 121

Milepoint	Feature	Data
10.30	Other	Junction KY 464 Heading West Road Surface Type - Flexible
10.70	Other	Junction KY 58/80 Heading NE-SW Road Surface Type - Flexible
11.73	Bridge	Number of Spans 4 Overpass Concrete T-Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed Pier 3 Fixed End 2 Fixed Deck Type - Concrete Length 192 feet Width 30 feet Pier Type - Open SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Stub End 2 Substructure - Stub Foundation Type - Unknown
11.80	Other	Purchase Parkway Road Surface Type - Flexible
12.00	Other	Mayfield City Limits Road Surface Type - Flexible
12.23	Other	Pond with Dam Road Surface Type - Flexible
12.30	Trees	Number of Trees 12 Height 45 feet Diameter 18 in. Ending Milepoint 12.31 Distance From Road 15 feet Road Surface Type - Flexible
12.60	Other	Junction KY 1890 Heading West Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
KY 121

Milepoint	Feature	Data
13.10	Trees	Number of Trees 12 Height 45 feet Diameter 18 in. Ending Milepoint 14.11 Distance From Road 15 feet Road Surface Type - Flexible
13.80	Fill	Material Type - Soil Height 20 feet Side slope 2:1 Length 50 feet Crest 26 feet Type Fill - Other Road Surface Type - Flexible
14.10	Trees	Number of Trees 12 Height 50 feet Diameter 10 in. Ending Milepoint 14.15 Distance From Road 20 feet Road Surface Type - Flexible
14.30	Trees	Number of Trees 12 Height 45 feet Diameter 18 in. Ending Milepoint 14.31 Distance From Road 15 feet Road Surface Type - Flexible
14.50	Other	Junction KY 1276 Heading East-West Road Surface Type - Flexible
15.30	Other	Junction KY 440 Heading North-West Road Surface Type - Flexible
16.10	Fill	Material Type - Soil Height 25 feet Side slope 2:1 Length 50 feet Crest 26 feet Type Fill - Other Road Surface Type - Flexible
17.70	Fill	Material Type - Soil Height 15 feet Side slope 2:1 Length 100 feet Crest 25 feet Type Fill - Other Road Surface Type - Flexible
18.20	Trees	Number of Trees 7 Height 45 feet Diameter 15 in. Ending Milepoint 18.21 Distance From Road 15 feet Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
KY 121

Milepoint	Feature	Data
18.50	Other	Pond with Dam Road Surface Type - Flexible
18.70	Trees	Number of Trees 7 Height 45 feet Diameter 15 in. Ending Milepoint 18.71 Distance From Road 15 feet Road Surface Type - Flexible
18.80	Fill	Material Type - Soil Height 15 feet Side slope 2:1 Length 100 feet Crest 25 feet Type Fill - Other Road Surface Type - Flexible
19.10	Other	Junction KY 1213 Heading North-South Road Surface Type - Flexible
19.20	Fill	Material Type - Soil Height 15 feet Side slope 2:1 Length 100 feet Crest 25 feet Type Fill - Other Road Surface Type - Flexible
20.00	Trees	Number of Trees 35 Height 45 feet Diameter 15 in. Ending Milepoint 20.50 Distance From Road 20 feet Road Surface Type - Flexible
20.19	Bridge	Number of Spans 5 Over Stream Concrete T-Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed Pier 3 Fixed Pier 4 Fixed End 2 Fixed Deck Type - Concrete Length 172 feet Width 24 feet Pier Type - Open SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown

Report by Road and Milepoint
for Graves County - Kentucky
KY 121

Milepoint	Feature	Data
20.70	Other	Junction KY 339 Heading North-South Road Surface Type - Flexible
21.50	Trees	Number of Trees 20 Height 45 feet Diameter 15 in. Ending Milepoint 21.51 Distance From Road 20 feet Road Surface Type - Flexible
21.70	Fill	Material Type - Soil Height 30 feet Side slope 2:1 Length 400 feet Crest 25 feet Type Fill - Other Road Surface Type - Flexible
21.70	Other	Collapsed Shoulder on South-Bound Lane Road Surface Type - Flexible
22.00	Fill	Material Type - Soil Height 25 feet Side slope 2:1 Length 50 feet Crest 30 feet Type Fill - Other Road Surface Type - Flexible
22.30	Fill	Material Type - Soil Height 25 feet Side slope 2:1 Length 50 feet Crest 25 feet Type Fill - Other Road Surface Type - Flexible
22.60	Other	Graves Co - Carlisle Co Boundary Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
US 45 / KY 58

Milepoint	Feature	Data
10.50	Other	Begin US 45/KY 80 Heading Northeast Road Surface Type - Flexible
10.54	Bridge	Number of Spans 4 Over Stream Concrete T-Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed Pier 3 Fixed End 2 Fixed Deck Type - Concrete Length 152 feet Width 28 feet Pier Type - Open SPC Rating - B Surface Type - Composite Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown
10.80	Power Line	Electrical Power Line 3 Lines Height 25 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
11.10	Other	Junction KY 1748 Heading Northeast Road Surface Type - Flexible
12.00	Other	Power Lines Parallel to Road (12 - 14.3) Milepoint Road Surface Type - Flexible
12.20	Bridge	Number of Spans 3 Over Stream Concrete T-Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed End 2 Fixed Deck Type - Concrete Length 87 feet Width 28 feet Pier Type - Solid SPC Rating - B Surface Type - Composite Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown

Report by Road and Milepoint
for Graves County - Kentucky
US 45 / KY 58

Milepoint	Feature	Data
13.10	Bridge	Number of Spans 1 Over Stream Concrete Box Beam End 1 Fixed End 2 Fixed Deck Type - Concrete Length 38 feet Width 27 feet Pier Type - Unknown SPC Rating - B Surface Type - Flexible Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown
14.15	Pipeline	Pipeline Type - Gas Road Surface Type - Flexible
14.20	Power Line	Electrical Power Line 3 Lines Height 30 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
14.25	Power Line	Electrical Power Line 3 Lines Height 30 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
15.02	Power Line	Electrical Power Line 3 Lines Height 35 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
15.02	Power Line	Power Lines Parallel to Road (15.0 - 16.0) Milepoint Road Surface Type - Flexible
15.70	Other	Mayfield City Limits Road Surface Type - Flexible
15.90	Power Line	Electrical Power Line 3 Lines Height 35 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
US 45

Milepoint	Feature	Data
0.00	Other	Graves Co - Hickman Co Boundary Road Surface Type - Flexible
0.20	Other	Junction KY 94 Heading East Road Surface Type - Flexible
0.20	Power Line	Electrical Power Line 3 Lines Height 30 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
0.20	Other	Junction KY 1529 Heading West Road Surface Type - Flexible
0.30	Trees	Number of Trees 50 Height 35 feet Diameter 30 in. Ending Milepoint .60 Distance From Road 5 feet Road Surface Type - Flexible
0.50	Other	Junction KY 2422 & KY 1283 Road Surface Type - Flexible
0.80	Power Line	Electrical Power Line 3 Lines Height 30 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
1.40	Trees	Number of Trees 35 Height 40 feet Diameter 24 in. Ending Milepoint 1.80 Distance From Road 10 feet Road Surface Type - Composite
1.68	Bridge	Number of Spans 3 Over Stream Concrete T-Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed End 2 Fixed Deck Type - Concrete Length 161 feet Width 19 feet Pier Type - Open SPC Rating - C Surface Type - Composite Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown

Report by Road and Milepoint
for Graves County - Kentucky
US 45

Milepoint	Feature	Data
1.80	Bridge	Number of Spans 1 Over Stream Concrete T-Beam End 1 Fixed End 2 Fixed Deck Type - Concrete Length 44 feet Width 19 feet Pier Type - Unknown SPC Rating - C Surface Type - Composite Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown
1.80	Trees	Number of Trees 30 Height 40 feet Diameter 10 in. Ending Milepoint 2.00 Distance From Road 15 feet Road Surface Type - Flexible
2.20	Power Line	Electrical Power Line 3 Lines Height 30 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
2.80	Power Line	Electrical Power Line 3 Lines Height 40 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
2.90	Trees	Number of Trees 100 Height 35 feet Diameter 18 in. Ending Milepoint 3.70 Distance From Road 15 feet Road Surface Type - Composite
2.90	Power Line	Electrical Power Line 3 Lines Height 30 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
3.03	Other	Shear Zone Road Surface Type - Flexible
3.41	Other	Mines - Gravel Pits (3.4 - 3.79) Milepoint Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
US 45

Milepoint	Feature	Data
3.80	Other	Junction KY 1763 Heading Northwest Road Surface Type - Flexible
3.90	Power Line	Electrical Power Line 3 Lines Height 30 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
4.39	Trees	Number of Trees 30 Height 50 feet Diameter 8 in. Ending Milepoint 4.40 Distance From Road 15 feet Road Surface Type - Flexible
5.60	Trees	Number of Trees 40 Height 50 feet Diameter 15 in. Ending Milepoint 5.80 Distance From Road 15 feet Road Surface Type - Flexible
6.09	Bridge	Number of Spans 3 Over Stream Concrete I-Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed End 2 Fixed Deck Type - Concrete Length 106 feet Width 30 feet Pier Type - Solid SPC Rating - C Surface Type - Composite Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown
6.70	Other	Junction KY 944 Heading West Road Surface Type - Flexible
6.81	Other	Gravel Pit Road Surface Type - Flexible
7.50	Other	Junction KY 339 Heading South Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
US 45

Milepoint	Feature	Data
7.55	Tank	Water Tank Number of Tanks 1 Capacity Unknown Distance From Road 150 feet Road Surface Type - Flexible
7.60	Other	Junction KY 339 & Purchase Parkway Road Surface Type - Flexible
7.80	Bridge	Number of Spans 1 Over Stream Concrete T-Beam End 1 Fixed End 2 Fixed Deck Type - Concrete Length 44 feet Width 19 feet Pier Type - Unknown SPC Rating - C Surface Type - Composite Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown
7.80	Trees	Number of Trees 50 Height 50 feet Diameter 16 in. Ending Milepoint 7.90 Distance From Road 15 feet Road Surface Type - Flexible
7.86	Bridge	Number of Spans 1 Over Stream Concrete T-Beam End 1 Fixed End 2 Fixed Deck Type - Concrete Length 34 feet Width 19 feet Pier Type - Unknown SPC Rating - C Surface Type - Composite Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown
7.91	Other	Gravel Pit Road Surface Type - Flexible
8.30	Trees	Number of Trees 3 Height 60 feet Diameter 24 in. Ending Milepoint 8.30 Distance From Road 10 feet Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
US 45

Milepoint	Feature	Data
8.75	Power Line	Electrical Power Line 3 Lines Height 35 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
10.40	Other	Electrical Power Line 3 Lines Height 25 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
10.40	Other	Power Line Parallel to Road (10.4 -0.0) Milepoint Road Surface Type - Flexible
10.50	Other	Junction KY 58 Heading Northeast Road Surface Type - Flexible
17.70	Fill	Material Type - Soil Height 45 feet Side slope 2:1 Length 500 feet Crest 30 feet Type Fill - Other Road Surface Type - Flexible
17.80	Bridge	Number of Spans 3 Overpass Concrete T-Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed End 2 Fixed Deck Type - Concrete Length 80 feet Width 20 feet Pier Type - Open SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Stub End 2 Substructure - Stub Foundation Type - Unknown
17.85	Fill	Material Type - Soil Height 45 feet Side slope 2:1 Length 500 feet Crest 30 feet Type Fill - Other Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
KY 58

Milepoint	Feature	Data
0.00	Other	Graves Co - Hickman Co Boundary Road Surface Type - Flexible
0.20	Trees	Number of Trees 30 Height 50 feet Diameter 15 in. Ending Milepoint 0.22 Distance From Road 15 feet Road Surface Type - Flexible
0.45	Other	Junction KY 1283 Heading South Road Surface Type - Flexible
0.50	Trees	Number of Trees 10 Height 50 feet Diameter 15 in. Ending Milepoint 0.51 Distance From Road 15 feet Road Surface Type - Flexible
0.51	Bridge	Number of Spans 3 Over Stream Concrete T-Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed End 2 Fixed Deck Type - Concrete Length 145 feet Width 19 feet Pier Type - Open SPC Rating - C Surface Type - Composite Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown
0.60	Trees	Number of Trees 10 Height 50 feet Diameter 15 in. Ending Milepoint 0.70 Distance From Road 15 feet Road Surface Type - Flexible
0.90	Trees	Number of Trees 300 Height 50 feet Diameter 15 in. Ending Milepoint 1.50 Distance From Road 15 feet Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
KY 58

Milepoint	Feature	Data
0.95	Other	Quarry Road Surface Type - Flexible
1.60	Other	Junction KY 339 Heading Southeast Road Surface Type - Flexible
2.10	Trees	Number of Trees 30 Height 50 feet Diameter 15 in. Ending Milepoint 2.20 Distance From Road 20 feet Road Surface Type - Flexible
2.40	Trees	Number of Trees 1 Height 50 feet Diameter 23 in. Ending Milepoint 2.40 Distance From Road 10 feet Road Surface Type - Flexible
2.60	Trees	Number of Trees 75 Height 35 feet Diameter 10 in. Ending Milepoint 2.80 Distance From Road 15 feet Road Surface Type - Flexible
2.83	Bridge	Number of Spans 2 Over Stream Concrete T-Beam End 1 Fixed Pier 1 Fixed End 2 Fixed Deck Type - Concrete Length 86 feet Width 19 feet Pier Type - Unknown SPC Rating - C Surface Type - Composite Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown
3.10	Trees	Number of Trees 400 Height 45 feet Diameter 15 in. Ending Milepoint 4.20 Distance From Road 10 feet Road Surface Type - Flexible
3.90	Fill	Material Type - Soil Height 20 feet Side slope 2:1 Length 75 feet Crest 25 feet Type Fill - Other Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
KY 58

Milepoint	Feature	Data
4.50	Trees	Number of Trees 20 Height 45 feet Diameter 15 in. Ending Milepoint 4.51 Distance From Road 10 feet Road Surface Type - Flexible
4.90	Trees	Number of Trees 50 Height 50 feet Diameter 12 in. Ending Milepoint 5.10 Distance From Road 20 feet Road Surface Type - Flexible
5.10	Fill	Material Type - Soil Height 40 feet Side slope 2:1 Length 1,000 feet Crest 24 feet Type Fill - Other Road Surface Type - Flexible
5.27	Bridge	Number of Spans 2 Overpass Concrete T-Beam End 1 Fixed Pier 1 Fixed End 2 Fixed Deck Type - Concrete Length 230 feet Width 28 feet Pier Type - Unknown SPC Rating - C Surface Type - Composite Expansion Type - Sliding Plate End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown
5.30	Fill	Material Type - Soil Height 40 feet Side slope 2:1 Length 250 feet Crest 24 feet Type Fill - Other Road Surface Type - Flexible
5.45	Other	Continued from US 45 (10.6 Milepoint) Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
KY 58 / KY 80

Milepoint	Feature	Data
5.40	Other	Junction KY 58/80 Heading East Road Surface Type - Flexible
5.50	Building	Urban Location Masonary Building Floors 5 Area/Floor 40,000 sq.ft. Road Surface Type - Flexible Other Use
5.70	Building	Urban Location Masonary Building Floors 4 Area/Floor 90,000 sq.ft. Road Surface Type - Flexible Community Use
5.70	Other	Downtown Mayfield Road Surface Type - Flexible
6.68	Bridge	Number of Spans 3 Over Stream Concrete I-Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed End 2 Fixed Deck Type - Concrete Length 159 feet Width 40 feet Pier Type - Open SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown
6.80	Power Line	Electrical Power Line 3 Lines Height 30 feet Wood Support Structure Unknown Volts Road Surface Type - Flexible
7.22	Other	Dam with Fill Road Surface Type - Flexible
7.30	Other	Junction KY 1710 Heading North Road Surface Type - Flexible
7.30	Pipeline	Pipeline Type - Gas Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
KY 58 / KY 80

Milepoint	Feature	Data
8.08	Trees	Number of Trees 10 Height 40 feet Diameter 18 in. Ending Milepoint 8.10 Distance From Road 15 feet Road Surface Type - Flexible
8.20	Other	Junction KY 131 Heading North Road Surface Type - Flexible
9.20	Trees	Number of Trees 10 Height 60 feet Diameter 18 in. Ending Milepoint 9.40 Distance From Road 15 feet Road Surface Type - Flexible
9.75	Trees	Number of Trees 1 Height 60 feet Diameter 20 in. Ending Milepoint 9.75 Distance From Road 15 feet Road Surface Type - Flexible
9.80	Trees	Number of Trees 1 Height 60 feet Diameter 20 in. Ending Milepoint 9.80 Distance From Road 15 feet Road Surface Type - Flexible
9.90	Fill	Material Type - Soil Height 15 feet Side slope 2:1 Length 200 feet Crest 25 feet Type Fill - Other Road Surface Type - Flexible
10.60	Trees	Number of Trees 3 Height 60 feet Diameter 18 in. Ending Milepoint 10.60 Distance From Road 15 feet Road Surface Type - Flexible
10.90	Trees	Number of Trees 20 Height 40 feet Diameter 16 in. Ending Milepoint 11.10 Distance From Road 10 feet Road Surface Type - Flexible

Report by Road and Milepoint
for Graves County - Kentucky
KY 58 / KY 80

Milepoint	Feature	Data
11.30	Trees	Number of Trees 2 Height 60 feet Diameter 18 in. Ending Milepoint 11.30 Distance From Road 15 feet Road Surface Type - Flexible
11.40	Trees	Number of Trees 2 Height 60 feet Diameter 18 in. Ending Milepoint 11.40 Distance From Road 15 feet Road Surface Type - Flexible
11.80	Trees	Number of Trees 2 Height 60 feet Diameter 18 in. Ending Milepoint 11.80 Distance From Road 15 feet Road Surface Type - Flexible
11.86	Trees	Number of Trees 15 Height 30 feet Diameter 24 in. Ending Milepoint 11.90 Distance From Road 15 feet Road Surface Type - Flexible
12.10	Trees	Number of Trees 500 Height 35 feet Diameter 18 in. Ending Milepoint 13.20 Distance From Road 18 feet Road Surface Type - Flexible
12.10	Other	Junction KY 301 Heading North Road Surface Type - Flexible
12.25	Bridge	Number of Spans 3 Over Stream Concrete T-Beam End 1 Fixed Pier 1 Fixed Pier 2 Fixed End 2 Fixed Deck Type - Concrete Length 112 feet Width 19 feet Pier Type - Solid SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown

Report by Road and Milepoint
for Graves County - Kentucky
KY 58 / KY 80

Milepoint	Feature	Data
12.44	Bridge	Number of Spans 1 Over Stream Concrete T-Beam End 1 Fixed End 2 Fixed Deck Type - Concrete Length 38 feet Width 19 feet Pier Type - Unknown SPC Rating - C Surface Type - Flexible Expansion Type - Other End 1 Substructure - Full End 2 Substructure - Full Foundation Type - Unknown
13.50	Trees	Number of Trees 30 Height 50 feet Diameter 17 in. Ending Milepoint 14.00 Distance From Road 15 feet Road Surface Type - Flexible
13.70	Fill	Material Type - Soil Height 30 feet Side slope 2:1 Length 150 feet Crest 30 feet Type Fill - Other Road Surface Type - Flexible
14.30	Other	Junction KY 564 Heading South Road Surface Type - Flexible
14.40	Power Line	Electrical Power Line 6 Lines Height 50 feet Steel Support Structure Unknown Volts Road Surface Type - Flexible
14.40	Other	Steel Tower: 100 feet high, 75 feet from road Road Surface Type - Flexible
14.50	Trees	Number of Trees 30 Height 45 feet Diameter 15 in. Ending Milepoint 14.60 Distance From Road 20 feet Road Surface Type - Flexible
14.80	Other	Graves Co - Marshall Co Boundary Road Surface Type - Flexible